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Transport Information and Control Systems

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November 16, 1997

TITLE:

NP 15627 (ENV12795) - Road Transport and Traffic Telematics (RTTT) - Dedicated Short Range Communication (DSRC) - Data Link Layer: Medium Access and Logical Link Control

SOURCE:

ISO/TC204/WG15

REQUESTED ACTION:

For CD Comment

Although official date for reply is February 17th, please reply by February 1st (if possible) as WG 15 is working to resolve comments.

DISTRIBUTION:

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Circulated to P- and O-members, and to technical committees and organizations in liaison for:

___ discussion at _____
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___ voting (P-members only; ballot form attached) for approval for registration as a DIS (see 2.5.7 of part 1 of the ISO/IEC Directives) by

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P-members of the technical committee or sub-committee concerned have an obligation to vote.

Title (English)

NP15627 (ENV 12795) - Road Transport and Traffic Telematics (RTTT) - Dedicated Short Range Communication (DSRC) - Data Link Layer: Medium Access and Logical Link

Title (French)

Reference language version: _x_ *English* ___ *French* ___ *Russion*

ntroductory note

UDC
Descriptors: ...

English version

Road Traffic and Transport Telematics (RTTT)
Dedicated Short Range Communication (DSRC)
DSRC Data Link Layer: Medium Access and Logical Link Control

Télématique de la Circulation et du Transport Routier
Communication dédiée, à courte distance
Couche Liaison: Méchanisme d'accès au média et contrôle du lien logique

Telematik für Straßenverkehr und Transport
Nahbereichskommunikation Bake-Fahrzeug
Datensicherungsschicht: Kanalzugriff und Verbindungssteuerung

This draft European Prestandard is submitted to CEN members for formal vote.

It has been drawn up by CEN TC278 WG9 SG.L2 and CEN Project Team M018/PT07

CEN members shall make the ENV available at national level in an appropriate form promptly and announce its existence in the same way as for EN or HD. Existing conflicting national standards may be kept in force (in parallel with the ENV) until the final decision about the possible conversion of the ENV into an EN is reached. The lifetime of an ENV is first limited to three years. After two years the Central Secretariat shall take action by requesting members to send in comments on that ENV within six months. The comments received will be transmitted to the Technical Board for further action as follows:

- conversion into an EN after formal vote;
- or extension of the life of an ENV for another two years (once only);
- or replacement by a revised ENV approved in accordance with 7.2 and 7.3 of the CEN/CLC Internal Regulations Part 2;
- or withdrawal of the ENV;
- or assignment to a technical body of the task of assisting the Technical Board to reach any of the decisions listed above.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardisation
Comité Européen de Normalisation
Europäisches Komitee für Normung
Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Prestandard has been prepared by Technical Committee CEN/TC 278 "Road transport and traffic telematics", the secretariat of which is held by NNI.

This European Prestandard was prepared by CEN TC278 WG9 "Dedicated Short-Range Communication", using its Subgroup L2 and the Project team CEN TC278 M018 PT07 to pursue its objective which is covered by TC278 Work Item WI 9.2.3 .

The subject Prestandard forms a part of a series of Prestandards defining the framework of a Dedicated Short Range Communication (DSRC) link in the RTTT environment. For basic information about RTTT application requirements and the resulting concept for DSRC, please refer the Internal Technical Report TC 278 N198 "DSRC - 1st Status Report

In addition to this Prestandard, the following parts will also be issued by CEN TC278 to build a complete set of Prestandards for the DSRC link:

prENV 12253	"DSRC Physical Layer using Microwave at 5.8 GHz"; CEN TC278 Work Item 00278 092; document N 473
prENV278/9/#63	"DSRC Physical Layer using Infrared at 850 nm"; CEN TC278 Work Item 00278 093; document N 526
prENV278/9/#64	**"DSRC Data Link Layer: MAC and LLC"; CEN TC278 Work Item 00278 053; document N 474**
prENV278/9/#65	"DSRC Application Layer"; CEN TC278 Work Item 00278 051, document N 505
prENV278/9/#74	"DSRC Communication Profiles"; CEN TC278 Work Item 00278 xxx, document N 6xx

WG9 consists of experts mainly from telecommunication sector and also from transport sector. Most active participating companies and organisations are:

Austria:	Alcatel, Efkon, Kapsch
France:	CGA, ISIS, Renault, Thomson
Germany:	Alcatel-SEL, Bosch-Telecom (ANT), Daimler-Benz Aerospace, RWTH, Siemens
Italy:	Alenia Marconi, Autostrade, UNINFO
Netherlands:	CMG
Norway:	Micro Design
Sweden:	SAAB Combitech Traffic, Telia Research
United Kingdom:	GEC Marconi, Peek plc, STCL

Additional contributions came from non-European experts from USA and Japan via ISO TC204 WG15, especially from Japan and USA.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Prestandard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden Switzerland and the United Kingdom.

Document Change Control Record (Informative)

Registration by CEN TC278	Ver-sion	Date	Change description
N 399 N 418 N 453	3.1	1995-03-18 1995-04-04 1995-07-12	First presentation(s) of prENV document to CEN TC278 (stage 32)
N 474	3.3	1995-09-25	Modification of version 3.1 acc. to received comments
N 6**	4.0	1996-12-10	(1) New 'Introduction' covering the TC278 Resolution 16.11 from 1996-09-26 *(in italics)*; (2) Regular update of various reference numbers

Contents (Informative)

INTRODUCTION (Informative)

Dedicated Short-range Communication is intended to be a communication means for Road Traffic and Transport Telematics (RTTT) applications, amongst others such as Automatic Fee Collection (AFC), Automatic Vehicle and Equipment Identification (AVI/AEI) and Traffic and Traveller Information (TTI).

This European Prestandard caters for on-board units based on transponder as well as transceiver technologies, and allows for interoperability between systems based on both of these technologies. Furthermore, the Prestandard allows for mixed time, frequency and space division multiple access approaches.

Resolution 16.10 taken by CEN/TC 278 on 1996-09-26:

Subject: CEN/TC 278 - DSRC Standards for 5.8GHz

CEN/TC 278, in view of the high priority accorded by industry, road operators and the European Commission to establish DSRC standards (DSRC layer 1, layer 2 and layer 7) taking account of the problems encountered in gaining consensus caused by the presence in some countries of large populations of already deployed pre-existing systems, resolves that:

1) *it reaffirms the results of the work undertaken by WG 9 and reaffirms its commitment to the draft DSRC Standards (layer 1, layer 2, layer 7) for pan European use at 5.8 GHz.*

2) *it also recognises that already established and deployed systems in large scale should be tolerated as long as they are in the public domain and can co-exist with the DSRC Standards (for layer 1, layer 2 and layer 7) and wishes to enable and encourage their migration towards* ***full interoperability.***

3) *it recognises that on-board equipment operating according to the DSRC Standards (layer 1, 2 and 7) does not interfere with tolling systems mentioned in .2) above working in the 5.8 GHz band.*

4) *it requires that the path by which interoperability and migration is to be achieved remains the responsibility of those not using the preferred specification.*

5) *it recognises that future applications may require expansion of the available bandwidth at 5.8GHz and will do its utmost in co-operation with ETSI to persuade CEPT to expand the available bandwidth.*

TITLE (Normative)

(a) Road Traffic and Transport Telematics (RTTT),

(b) Dedicated Short-Range Communication (DSRC),

(c) DSRC Data Link Layer: Medium Access and Logical Link Control

1. SCOPE (Normative)

This European draft standard ...

- is positioned with respect to other related standards by the layers defined in the Reference Model for Open Systems Interconnection (ISO7498 : 1984) as adopted for the dedicated short-range communication (DSRC).
- defines the Data Link Layer irrespective of the physical medium to be used.
- applies to DSRC between Fixed Equipment at the roadside and Mobile Equipment in vehicles. This standard does neither apply to vehicle to vehicle communication nor, to communication, between different instances of Fixed Equipment.
- adheres to the general DSRC architecture in which the Fixed Equipment controls the medium, allocating its use to Mobile Equipment within range of the Fixed Equipment. It supports simplex and half duplex transmission modes and caters for the use of semi-passive (transponder) as well as semi-active (transceiver) Mobile Equipment.
- supports a variety of Fixed Equipment configurations. It supports configurations where one Fixed Equipment communicates with one Mobile Equipment unit, as well as configurations where one Fixed Equipment can communicate with several Mobile Equipment units. It does neither define any specific configuration nor layout of the communication zone.
- does not define to what extent different instances of Fixed Equipment, operating in the vicinity of each other, need to be synchronised with each other.
- defines parameters to be used in negotiation procedures taking place between Fixed Equipment and Mobile Equipment.

By defining two distinct sublayers, namely the medium access control (MAC) sublayer and the logical link control (LLC) sublayer, this standard defines:

a) medium access control procedures for the shared physical medium

b) addressing rules and conventions

c) data flow control procedures

d) acknowledgement procedures

e) error control procedures

f) services provided to data link user(s)

The MAC sublayer is specific to the DSRC while the LLC sublayer is adopted from a subset of ISO 8802-2 : 1989. The services offered are unacknowledged (Type 1) and acknowledged (Type 3) connectionless services.

This standard takes into account that each Fixed Equipment covers a limited part of the road (the communication zone) and that the Mobile Equipment communicates with the Fixed Equipment while passing through the communication zone.

2. REFERENCES (Normative)

This standard incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references the latest of the publication referred to applies.

ISO 4335 : 1987	Information processing systems, Data communications, High-level data link control elements of procedures
ISO 7498 : 1984	Information Technology - Open Systems Interconnection - Basic Reference Model : The Basic Reference Model
ISO 7809 : 1984	Information processing systems, Data communications, High-level data link control procedures, Consolidation of classes of procedures
ISO 8802-2 : 1989	Local Area Networks - Part 2: Logical Link Control; ISO 8802-2 : 1989, Local Area Networks - Part 2: Logical Link Control, ADDENDUM 2: Acknowledged Connectionless-Mode Service and Protocol, Type 3 Operation
ISO IS 3309 : 1984	Information processing systems - Data communication - High-level data link control procedures - Frame structure
CCITT Recom. X.25	Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit
CCITT Recom. X.200	Reference model on open systems interconnection for CCITT applications.

3. DEFINITIONS and ABBREVIATIONS (Normative)

3.1 Definitions

For the purposes of this standard, the following definitions apply:

Beacon Service Table

A communication service table defining a set of parameters necessary for a Mobile Equipment to communicate with a Fixed Equipment. Parameters include transmission medium characteristics, frame length, inter frame gap length, uplink window size, timer values, counter values, etc. The Beacon Service Table is maintained by the Application Layer (which is the Data Link Layer user).

Broadcast Link Address

The predefined SAP address used as a broadcast (all parties) address. It can never be the address of a single SAP on the data link.

Command

An instruction in data communications. It is represented in the control field of a PDU and transmitted by an LLC. It causes the addressed LLC(s) to execute a specific data link control function.

Data Link

An assembly of two or more terminal installations and the interconnecting communications channel operating according to a particular method that permits information to be exchanged. In this standard the term terminal installation does not include the data source and the data sink.

Data Link Layer

The conceptual layer of control or processing logic existing in the hierarchical structure of a station that is responsible for maintaining control of the data link. The data link layer functions provide an interface between the station higher layer logic and the data link. These functions include address / control field interpretation, channel access and command PDU / response PDU generation, transmission, and interpretation.

Downlink

Communication channel on which the Fixed Equipment transmits its information.

Downlink Window

The period of time during which the Fixed Equipment is transmitting.

Fixed Equipment

A fixed communication facility, at the roadside, with a single downlink channel and one or more uplink channels. The Fixed Equipment corresponds to the beacon's (or roadside equipment's) communication unit.

Logical Link Control (LLC)

That part of communication facility that supports the logical link control functions of one or more logical links. The LLC generates command PDUs for transmission and interprets received command PDUs and response PDUs: Specific responsibilities assigned to an LLC include:

a) Organisation of data flow

b) Interpretation of received command PDUs and generation of appropriate response PDUs.

c) Actions regarding error control and error recovery functions.

LLC Control Field

The first field of a PDU. The content of the control field is interpreted by the receiving destination LLC(s), designated by the link address field, as a command, from the source LLC designated by the link address field, instructing the performance of some specific function, or as a response, from the source LLC designated by the link address field.

Link Address

The service access point address at the beginning of an LPDU which identifies the SAP designated to receive the PDU and the SAP transmitting the PDU.

Link Turn Around Time

The link turn around time is the time between two consecutive physical layer bit streams in opposite directions (which is used for switching from transmitting to receiving mode or vice versa) comprising physical layer protocol data units, i.e. layer 2 frames (including zero bit insertion) and pre- and postambles if applicable.

Logical Link Protocol Data Unit

A data unit delivered from or to the MAC sublayer.

Medium Access Control (MAC)

The part of a data station that supports the medium access control functions that reside just below the LLC sublayer. The procedures of this communication entity include framing of data units, error checking, and acquiring the right to use the underlying physical medium.

MAC Control Field

Part of a frame holding MAC relevant control information.

Multicast Address

A destination address assigned to a collection (group) of SAPs to facilitate their being addressed collectively.

Mobile Equipment

A mobile communication facility capable of receiving information from the Fixed Equipment on the downlink and, possibly, also capable of transmitting information on the uplink. The Mobile Equipment corresponds to the vehicle's communication unit.

Octet

A bit-oriented element that consists of eight contiguous binary bits, independently of 'zero bit insertion'.

Private Uplink Window

A private uplink window is the period of time which is allocated by the Fixed Equipment to a certain previously addressed Mobile Equipment for transmission.

Protocol Data Unit (PDU)

The sequence of contiguous octets delivered as an unit from or to the MAC sublayer. A valid LLC PDU (LPDU) is at least 1 octet in length and contain, an LLC Control Field. An LPDU may or may not include an information field.

Public Uplink Window

A public uplink window is the time period during which any Mobile Equipment is allowed to transmit, according to certain rules, in contention with other Mobile Equipment.

Response

In data communications, a reply represented in the control field of a response PDU. It advises the destination LLC of the action taken by the source LLC to one or more command PDUs.

Service

The capabilities and features provided by N-layer to N-user.

Uplink

Communication channel on which Mobile Equipment transmits its information.

Uplink Window

A time period during which Mobile Equipment can transmit.

Window

A period of time during which the physical medium is allocated, by the Fixed Equipment for transmission by either the Fixed Equipment (downlink window) or by the Mobile Equipment (public or private uplink window).

3.2 Abbreviations

For the purposes of this standard, the following abbreviations apply:

ACK	ACKnowledge
Acn	ACknowledged command / response
BST	Beacon Service Table

CCITT	International Telegraph and Telephone Consultative Committee
C/R	Command/Response
F	Final
FCS	Frame Check Sequence
FE	Fixed Equipment
HDLC	High-level Data Link Control
ISO	International Organisation for Standardisation
LPDU	Logical Link Control Layer Protocol Data Unit
LLC	Logic Link Control
LSDU	Link layer Service Data Unit
M	Modifier function bit
MAC	Medium Access Control
ME	Mobile Equipment
OSI	Open Systems Interconnection
P	Poll
PDU	Protocol Data Unit
P/F	Poll/Final
R	Response
RR	Response Request
SAP	Service Access Point
UA	Unnumbered Acknowledgement
UI	Unnumbered Information

Variables:

V(A)	private medium allocation state variable (MAC)
V(PUB)	first public uplink window transmission indicator (MAC)
V(RI)	receive state variable (LLC)
V(SI)	transmit state variable (LLC)
V(RB)	reception state variable (LLC)
N1	number of octets required for data link address
N2	maximum number of octets in frame in downlink window (MAC)
N3	maximum number of octets in frame in private uplink window (MAC)
N4	maximum number of octets in frame in public uplink window (MAC)
N5	number of simultaneously allocated consecutive public uplink windows (MAC)
N6	public uplink window counter
N7	random delay counter value (MAC)
N8	maximum value for random delay counter (MAC)
N9	maximum value of private uplink window allocation counter (MAC)
N10	maximum number of octets in a LPDU (LLC)
N11	maximum number of retransmissions (LLC)
T1	minimum uplink to downlink turn around time (MAC)
T2	minimum downlink to downlink window time (MAC)
T3	downlink to uplink turn around time (MAC)
T4a	maximum time before start of transmission in private uplink window (MAC)
T4b	maximum time before start of transmission in public uplink window (MAC)
T5	time duration of public uplink window (MAC)

N12	maximum private medium response time (MAC)
N13	acknowledgement time, if not indicated N13FE and N13ME is meant (LLC)
N13FE	acknowledgement time of Fixed Equipment (LLC)
N13ME	acknowledgement time of Mobile Equipment (LLC)

4. FRAME FORMAT

All transmissions are in frames, and each frame conforms to the structure shown in figure 1a and figure 1b.

Flag	Link Address	MAC Control Field	LPDU	Frame Check Sequence	Flag

Figure 1a: Frame Structure

Frames containing only MAC control field form a special case where there is no LLC PDU (LPDU) (see figure 1b).

Flag	Link Address	MAC Control Field	Frame Check Sequence	Flag

Figure 1b: MAC Frame Structure, containing only MAC Control Field

NOTE: It should be noted that the physical bit stream may also comprise either a preamble and / or a postamble encapsulating a layer 2 frame (including zero bit insertion; see figure 2). The length and pattern of the pre- and postambles, if applicable, are outside the scope of this standard. The whole length of the physical bit stream (layer 2 frame + Pre- / Postamble) shall be taken into account for the calculation of the size of windows.

Preamble	Layer 2 frame (including zero bit insertion)	Postamble

Figure 2: Physical layer bit stream including pre- and postambles encapsulating a layer 2 frame

4.1 Flag Sequence

All frames shall start and end with the flag sequence. This sequence is a zero bit followed by 6 one bits followed by a zero bit (*0111 1110*). When in receiving state, all stations shall continuously

check on a bit-by-bit basis for this sequence. A transmitter shall send only complete eight bit flag sequences.

The sequence which ends a frame shall not be used as the start flag sequence for the next frame.

In order to achieve transparency the flag sequence is prohibited from occurring in the Data Link Address, MAC control field, LPDU and Frame Check Sequence via a zero bit insertion procedure described in subclause 4.7.

NOTE: Different to the ISO IS 3309 : 1984 two flags should be 16 bits, i.e. two flags should be represented by 0111 1110 0111 1110. The last eight bits of the pattern sequence 0111 1110 1111 110 should be interpreted as a valid start flag.

4.2 Link Address Field

The address field shall contain the link address. The link address field is a sequence of up to N1 octets which comprises one address which shall be either a private link address, a multicast link address or a broadcast link address. When the first bit of an address octet is *0*, the subsequent octet shall be an extension of the address field (see figure 3). The address field shall be terminated by an octet having a *1* in bit position one. Thus the address field is recursively expandable.

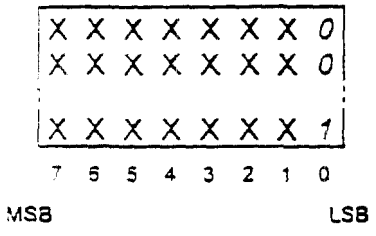


Figure 3: Link Address Field Format

The single octet address of eight *1* bits *(1111 1111)* shall be reserved as the broadcast address (see figure 4). All single octet addresses other than the broadcast address shall be reserved for the multicast addresses (see figure 5). Any address containing more than *1* octet shall be a private link address.

NOTE 1: The assignment of multicast addresses is outside the scope of this standard.

NOTE 2: The address of the SAP is equal to the content of the link address field.

NOTE 3: The length of the private link address is defined in the BST by the parameter N1

NOTE 4: Unlike ISO 8802-2:1989 there is no null address and therefore the '0000 0001' is a valid multicast address.

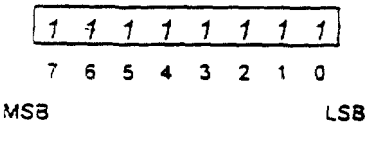


Figure 4: Link Address Field Format of the Broadcast Address

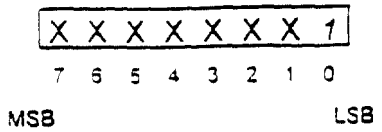


Figure 5: Link Address Field Format of the Multicast Address

4.3 MAC Control Field

The MAC control field is used to:

- indicate whether an LLC unit is available (in order to allow also data-less frames)
- indicate the transmission direction: uplink or downlink (e.g. in order to detect reflected data packets or interference between FEs)
- allocate public and private windows (medium allocation code on the downlink)
- request for private windows (medium request code on the uplink).
- specify type of LLC unit

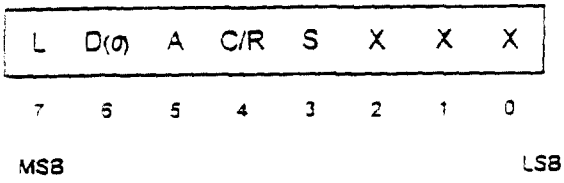
Bits which are not specified are reserved for future use, e.g. for future enhancement and optimisation of the link using window management functions (dynamic adaptation of control parameters).

The MAC control field shall contain the MAC information and the Command/Response identifier of the LPDU. The MAC control field is a sequence of one octet. It has to be distinguished between the Downlink MAC control field and the Uplink MAC control field, which have different roles in the MAC. The Fixed Equipment is the master and the Mobile Equipment is slave of the medium.

NOTE: The MAC medium access parameters are defined in the BST (Application Layer)

4.3.1 MAC Control Field of the Downlink

The MAC control field of the Downlink shall be used by frames transmitted by the Fixed Equipment. The format is described in figure 6.



L The LPDU Existence Bit shall be used to indicate if the frame contains an LPDU.
0 = frame contains no LPDU
1 = frame contains LPDU

D Direction identifier bit
0 = downlink direction.

A The Medium Allocation Bit shall be used to allocate medium (see clause 6).
0 = no window is allocated by the Fixed Equipment
1 = window is allocated by the Fixed Equipment

C/R The LLC Command/Response Bit shall be used to identify the LPDU as Command or Response. The LLC Command/Response Bit shall be ignored if the LPDU Existence Bit is set to *0* (for the use of the C/R field see clause 7)
0 = command LPDU
1 = response LPDU

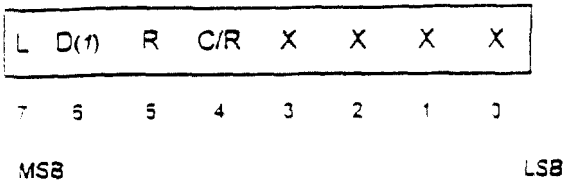
S MAC sequence bit

X Reserved, shall be set to *0*.

Figure 6: MAC Control Field of the Downlink

4.3.2 MAC Control Field of the Uplink

The MAC control field of the Uplink shall be used by frames transmitted by the Mobile Equipment. The format is described in figure 7.



L The LPDU Existence Bit shall be used to indicate if the frame contains an LPDU.
0 = frame contains no LPDU
1 = frame contains LPDU

D Direction identifier bit
1 = uplink direction

R The Medium Request Bit shall be used to request uplink window (see clause 6).
0 = no window is requested by Mobile Equipment
1 = window is requested by the Mobile Equipment

C/R The LLC Command/Response Bit shall be used to identify the LPDU as Command or Response. The LLC Command/Response Bit shall be ignored if the LPDU Existence Bit is set to *0* (for the use of the C/R field see clause 7)
0 = command LPDU
1 = response LPDU

X Reserved, shall be set to *0*.

Figure 7: MAC Control Field of the Uplink

4.4 LPDU Format

The LPDU shall have the encoding described in clause 7.

4.5 Frame Check Sequence

All frames shall include a 16-bit Frame Check Sequence (FCS) just prior to the end flag for error detection purposes. The contents of the Link Address, MAC control field and LPDU shall be included in the calculation of the FCS.

The FCS shall be compliant with 16-bit frame checking sequence as defined in ISO 3309 (clause 3.6.2). The generator polynomial shall $X^{16} + X^{12} + X^5 + 1$, and the initial value used shall be $FFFF_{16}$. The ones complement of the resulting remainder shall be transmitted as the 16-bit FCS.

4.6 Bit Order

Flag, Link address, MAC control field, and LPDU shall be transmitted least significant bit (LSB) first, i.e. low-order bit first (e.g. the first bit of the MAC control field transmitted shall have the weight 2^0).

The FCS shall be transmitted to the line commencing with the coefficient of the highest term.

4.7 Transparency

The occurrence of the flag sequence within a frame other than the start and / or end flags shall be prevented via a zero bit insertion procedure as follows:

The transmitter shall insert a *0* bit following five contiguous *1* bits anywhere between the start flag and the end flag of the frame. The insertion of the *0* bit thus applies to the contents of the Link address, the MAC control field, the LPDU and the FCS.

The receiver shall continuously monitor the received bit stream; after receiving five contiguous *1* bits, the receiver shall inspect the following bit. If it is a *0*, the five *1* bits are passed as data and the *0* is deleted. If the sixth bit is a *1*, the receiver shall inspect the seventh bit; if this bit is a 0, a valid flag has been received; if it is a *1*, an abort has been received, and the receiving station shall ignore that frame.

5. ADDRESS ESTABLISHMENT (Normative)

Each Fixed Equipment shall contain one broadcast SAP as well as one SAP for each mobile private SAP currently known by the Fixed Equipment to be in the communications zone.

The Fixed Equipment SAP corresponding to a private Mobile Equipment SAP may be created by the Fixed Equipment when a new private link address is detected by the data link layer (see subclause 5.3).

Each Mobile Equipment shall contain one broadcast SAP, and if required for uplink transmissions, one private SAP. In addition to that, it may contain one or more multicast SAPs.

The private SAP shall be available in the Mobile Equipment after arriving in a communications zone when the data link user has interpreted the BST and issued a request primitive using a new link address (see also subclause 5.2). The first public uplink window transmission indicator V(PUB) shall be set to *0*.

The address used on the data link layer is the link address. The same link address is used for the MAC sublayer and for the LLC sublayer. Figure 8 shows the link address overview.

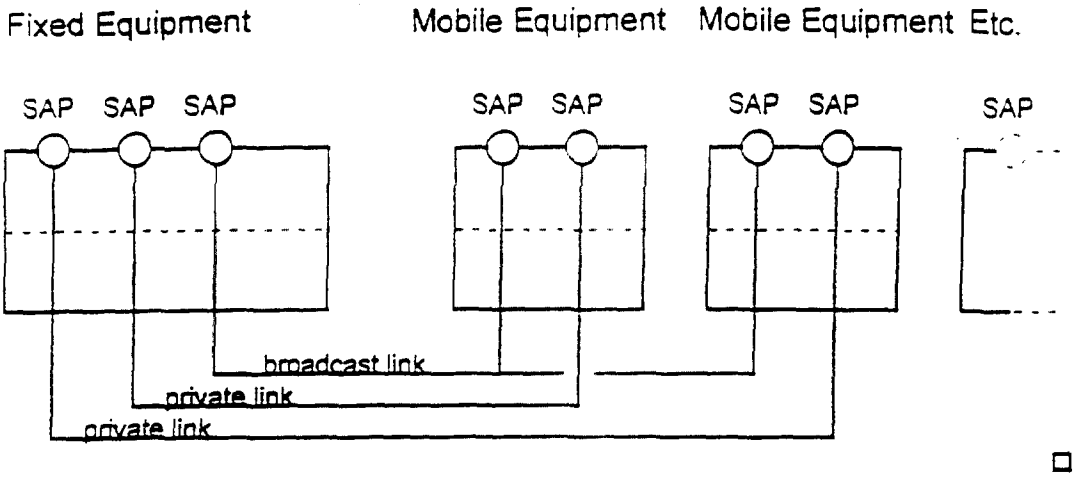


Figure 8: Link addressing overview

NOTE: Mobile Equipment (ME) arriving in the communications zone is in many cases not fully powered, but is in a mode with limited receive capability, sometimes called sleep mode. After arriving in the communications zone ME which is not fully powered switches to a fully powered state. This change of state is known as wake up.
If and how wake up is performed is outside the scope of this standard.
Address establishment is presumed to take place after wake up. Therefore, in the following subclauses, the ME is described as it were always fully powered.

5.1 Broadcast SAP Establishment

The broadcast SAP in all stations shall always be active (see also note in subclause 5.1).

NOTE: This is necessary to enable the reception of the BST, which is transmitted with a broadcast link address.

5.2 Mobile Private SAP Establishment

By receiving and decoding the BST, which is broadcast from the Fixed Equipment, the data link user of the Mobile Equipment can deduce all necessary parameters for the address establishment.

The mobile data link user shall create a new private link address when the identity of the Fixed Equipment (as received in the BST) is new. The private link address shall be a (pseudo)random address and shall consist of the number of octets indicated by parameter N1 and shall conform to the format described in subclause 4.2.

It is the responsibility of the data link layer to delete any private SAP and create a new private SAP when the link address of a request primitive is unequal to the old private link address.

The mobile data link entity shall use its private link address in all uplink transmissions.

NOTE 1 : Examples of mobile SAP establishment procedures are given in annex D.

NOTE 2 : The identity of the Fixed Equipment is also named 'beacon identity'.

5.3 Fixed Private SAP Establishment

When a Fixed Equipment data link entity receives a frame containing a private link address not known to it a corresponding SAP shall be created.

NOTE: Fixed private SAPs also need to be deleted, so as to avoid a potentially infinite number of SAPs. The deletion mechanism is outside the scope of this standard.

6. MEDIUM ACCESS CONTROL (MAC) SUBLAYER (Normative)

The MAC sublayer is responsible for controlling the use of the physical medium by the MAC sublayer entity residing in the Fixed Equipment (*Fixed MAC*) and the MAC sublayer entity residing in the Mobile Equipment (*Mobile MAC*).

The medium access control is characterised by:

- half duplex mode
- asynchronous time division multiple access (TDMA)

The medium access control is unbalanced, in that the Fixed Equipment is always in control of the physical medium, granting access to the physical medium to either:

- the fixed MAC (downlink window) or
- one mobile MAC exclusively (private uplink window) or
- any mobile MAC, according to certain rules (public uplink window)

Uplink windows allocated by the fixed MAC are indicated by the MAC control field of the downlink frame and follow immediately after the downlink window containing the frame.

The distinction between allocation of public and private uplink windows is made by the fixed MAC by means of the link address of the frame allocating the uplink window. A public uplink window is allocated if one link address field contains a broadcast address while a private uplink window is allocated if the link address field contains the address of this specific Mobile Equipment.

The mobile MAC can also request access to the medium.

The MAC sublayer offers the *X*-MA-DATA primitives to the LLC sublayer.

The primitives are different in the fixed MAC and in the mobile MAC and they are therefore divided into F-MA-DATA primitives and M-MA-DATA primitives.

See figure 9 for a window management overview

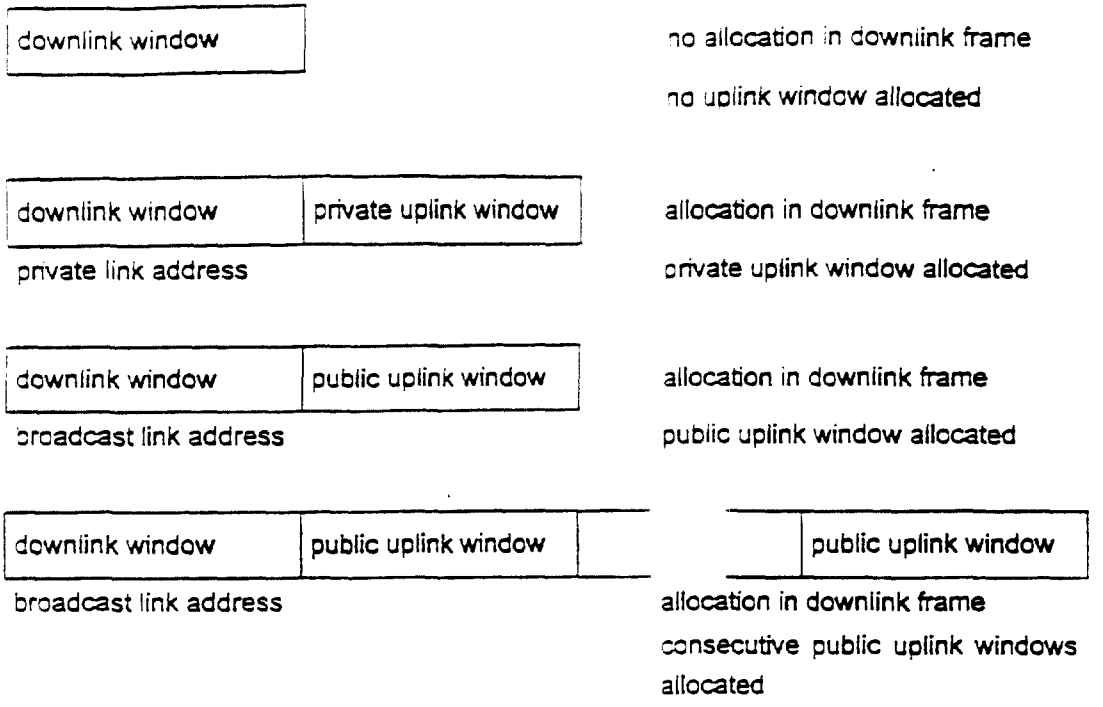


Figure 9: Window Management Overview

6.1 Window Management

6.1.1 Downlink Windows

The *Fixed MAC* allocates a downlink window simply by transmitting a frame.

The start of a downlink window occurs at the start of the first bit of the preamble if applicable or otherwise the first bit of the start flag of the downlink layer 2 frame transmitted.

A downlink window shall not start before T1 after the end of the previous window if the previous window is an uplink window.

A downlink window shall not start before T2 after the end of the previous window if the previous window is a downlink window.

The end of a downlink window occurs at the end of the last bit of the postamble if applicable or otherwise the last bit of the end flag of the downlink layer 2 frame transmitted.

A layer 2 frame transmitted in a downlink window shall consist of not more than N2 octets.